(12) UK Patent Application (19) GB (11) 2 193 282 (13) A

(43) Application published 3 Feb 1988

(21) Application No 8600078

(22) Date of filing 3 Jan 1986

(51) INT CL⁴
F16H 21/22

(52) Domestic classification (Edition J):
F2K 4A2
F1B 5R1E

(56) Documents cited
None

(58) Field of search
F2K
F1B
Selected US specifications from IPC sub-class F16H

(71) Applicant
Ford Motor Company Limited
(Incorporated in United Kingdom)
Eagle Way, Brentwood, Essex

(72) Inventor
Dr. Thomas Tsoi-Hei Ma

(74) Agent and/or Address for Service
A. Messulam & Co.,
24 Broadway, Leigh on Sea, Essex

(54) Cranking mechanism

(57) A cranking mechanism comprising a crankshaft (26), two non-aligned crankpins (12, 24) on the crankshaft (26), two slider blocks (18, 20) journalled for rotation about the respective crankpins (12, 24), and a connecting rod (10) having two mutually inclined slide ways (14, 16) each receiving and guiding a respective one of the slide blocks (18, 20).

By appropriate selection of the inclination of the slide ways (14, 16) relative to the longitudinal axis of the connecting rod (10), and the direction and the extent of the offset of the crankpins (12, 24) the locus of the connecting rod can be varied within broad limits.

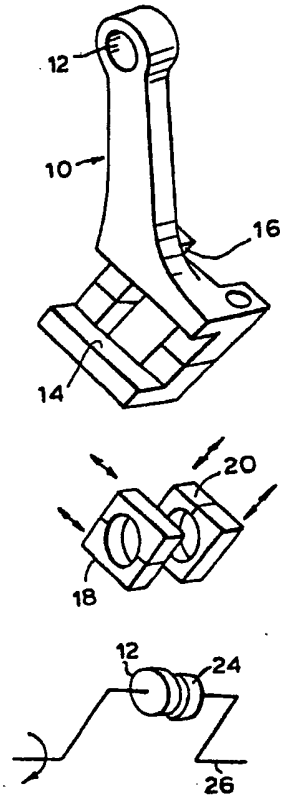

FIG.1.

GB 2 193 282 A

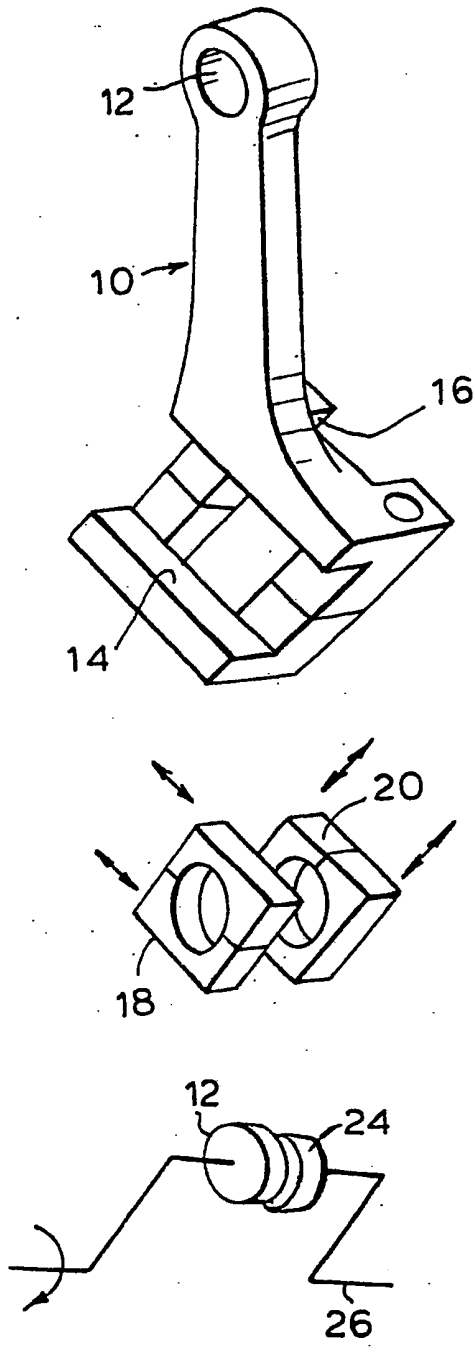

FIG.1.

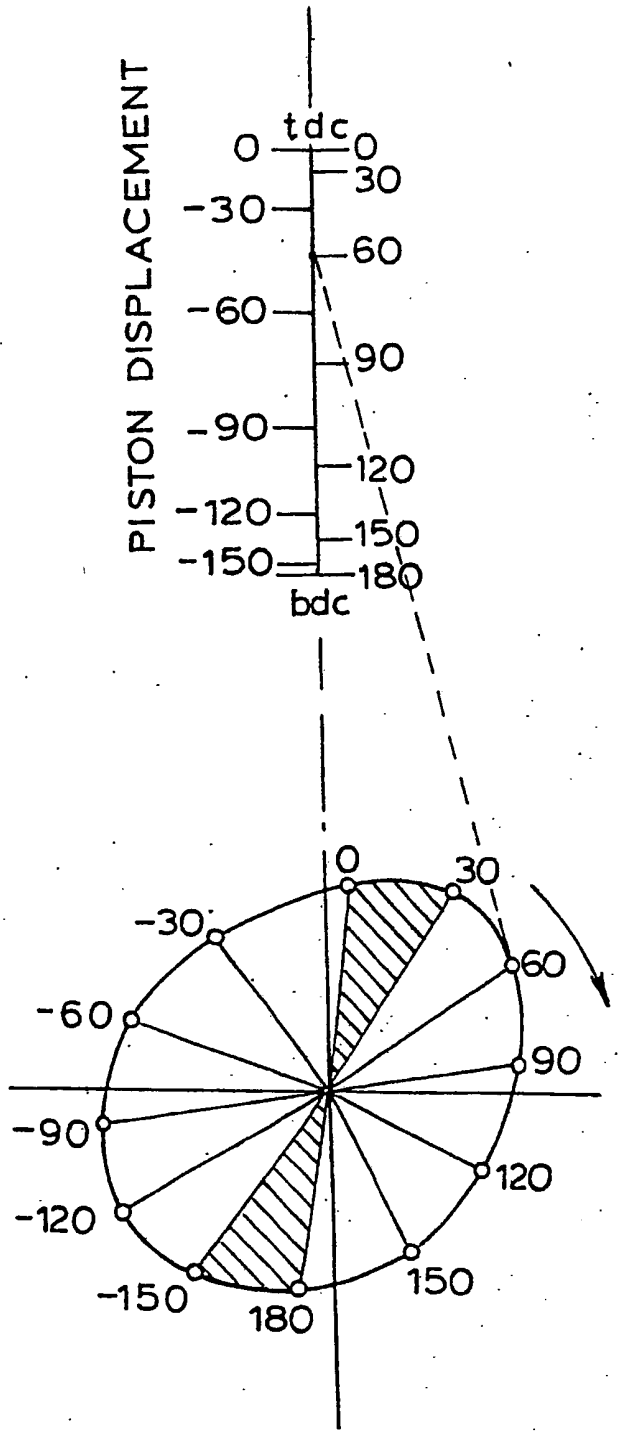

FIG. 2.

SPECIFICATION

Cranking mechanism

The present invention relates to a cranking mechanism that is to say a mechanism for converting reciprocating motion into rotary motion or vice versa.

The conventional form of cranking mechanism used in an internal combustion engine comprises a crankshaft having an eccentric crank pin which follows a circular path. The cranking pin is connected by way of a connecting rod to a piston which is guided in a cylinder to undergo a reciprocating motion during rotation of the crankshaft.

If the crankshaft rotates with constant speed, the result of this geometry is that the position of the piston as a function of time approximates to a sinusoid. The minor variation from a perfect sinusoid results from the fact that the connecting rod pivots during the course of the cycle and this causes the projection of the length of the connecting rod onto the axis of the cylinder to vary.

From the thermodynamic viewpoint, this relationship of the piston position with respect to time is not ideal and it is desirable to be able deviate from this generally sinusoidal relationship so as to vary the proportion of the cycle time that the piston spends in different positions in the cylinder.

The present invention seeks to provide a cranking mechansim which enables the lower end of a connecting rod to follow other than a circular path during the course of rotation of a crankshaft to which the connecting rod is coupled.

According to the present invention, there is provided a cranking mechanism comprising a crankshaft, two non-aligned crankpins on the crankshaft, two slider blocks journalled for rotation about the respective crankpins, and a connecting rod having two mutually inclined slide ways each receiving and guiding a respective one of the slide blocks.

Preferably, the slide ways on the connecting rod are mutually orthogonal.

The angle of inclination of the slide ways in relation to the longitudinal axis of the connecting rod determines the proportion of the load or thrust which must be born by the respective slideways and crankpins. To spread the load evenly between the two crankpins and slide ways, it is preferred to arrange the slide ways at an angle in the range of from 30° to 60° to the axis of the connecting rod. This inclination also affects the locus of the connecting rod and must be taken into consideration when designing the cranking mechanism to meet particular objectives.

In the preferred embodiment, the slideways are each disposed at an angle of 45° to the longitudinal axis of the connecting rod.

The axes of the crankpins may be offset from one another in a radial or tangential direction in relation to the rotational axis of the crankshaft.

For an internal combustion, it is preferred to offset the crankpins in a radial direction. This has the effect of causing the locus of the lower end of the connecting rod to follow a path which resembles an inclined egg. The result of this locus on the motion of the piston is that the piston dwells slightly near the top dead centre position giving more time to complete combustion. The modified motion of the piston also assists in scavenging and generally improves the engine efficiency.

It is important to note that though the invention finds use in an internal combustion engine, it can be used in other reciprocating machines and in each case it provides the freedom to determine the locus of the connecting rod so as to adapt the reciprocating motion to the needs of the cycle carried out by the machine.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic exploded view of a cranking mechanism of the invention, and

Figure 2 is a diagram illustrating the locus of the ends of the connecting rod.

In Fig. 1, a connecting rod 10 is formed with a conventional little end 12. In place of the usual big end bearing, the connecting rod is formed at its lower end with two orthogonal slide ways 14 and 16 which are formed one on each side of the connecting rod 10.

Each slide way 14, 16 receives and guides a respective one of two slider 18, 20, the connecting rod lower end being split to permit assembly. When received in the slide ways, the sliders 18, 20 can move in the directions indicated by arrows without applying any force to the connecting rod whereas movement at right angles to this direction moves the connecting rod 10. It can be seen therefore that the movement of the lower end of the connecting rod has two orthogonal components each determined by the position of a respective slider in the direction of that component.

The sliders 18 and 20 are slit so that they may be assembled about crankpins 22 and 24 eccentrically mounted on a crankshaft 26. The locus of the lower of the connecting rod is determined by the positions of the two crankpins pins relative to the axis of the crankshaft and upon the angle of inclication of the slide ways 14 and 16 relative to the longitudinal axis of the connecting rod 10.

For the arrangement illustrated in Fig. 1, the locus of movement of the connecting rod ends is shown in Fig. 2 calibrated in degrees of rotation of the crankshaft. This locus can readily be computed given that the nominal centre of the crossover of the two slide ways will always be determined uniquely by the po-

sition of the two crankpins.

As can be seen from Fig. 2, the locus of the lower end of the connecting rod is egg shaped and is inclined relative to the axis of the piston. This shape gives rise to several advantages which will now be described.

There is a dwell period in the piston displacement just behind tdc (from tdc to 30 deg atdc) where the combustion chamber volume increment above the clearance volume is reduced by approximately 50%. This approaches the ideal combustion condition at constant volume with positive work to a greater degree than the conventional crank giving better thermal efficiency, extended lean burn capability and lower hydrocarbon emission because of higher gas temperatures.

This is followed by a faster expansion stroke, another dwell period of the piston just behind bdc (from bdc to 30° abtc), and a faster exhaust stroke.

The same piston-crank movements repeated for the next two strokes give a faster induction and better dynamic charging immediately behind bdc (larger trapped volume), followed by a faster compression to reach tdc.

The thrust angle of the control rod is reduced by about 15% allowing a smaller l/r ratio and and/or less friction, less side-thrust.

The locus of the lower end of the connecting rod is determined by the separation of the crankpins, the direction of the offset of the crankpins in relation to the crank radius and the inclination of the slide ways in relation to the longitudinal axis of the connecting rod. Variations of these parameters can allow the locus to be varied at will.

The asymmetrical configuration described above is preferred for the reasons stated but it should be mentioned that other arrangement also yield certain advantages. In particular, it is possible to retain symmetry of the locus of the connecting rod and while this looses the ideal of constant volume combustion it reduces the side-thrust by up to 30%.

CLAIMS

1. A cranking mechanism comprising a crankshaft, two non-aligned crankpins on the crankshaft, two slider blocks journalled for rotation about the respective crankpins, and a connecting rod having two mutually inclined slide ways each receiving and guiding a respective one of the slide blocks.

2. A cranking mechanism as claimed in claim 1, wherein the slide ways on the connecting rod are mutually orthogonal.

3. A cranking mechanism as claimed in claim 2, wherein the slideways are each disposed at an angle in the range from 30° to 60° to the longitudinal axis of the connecting rod.

4. A cranking mechanism as claimed in claim 3, wherein the slideways are each disposed at an angle of 45° to the longitudinal axis of the connecting rod.

5. A cranking mechanism as claimed in any preceding claim, wherein the crankpins are offset in a radial direction with respect to the crankshaft axis.

6. A cranking mechanism constructed and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

Published 1988 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office, Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Burgess & Son (Abingdon) Ltd. Con. 1/87.